



max planck institut
informatik

Wissen im Web: von O bis W

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Max Planck Institute for Informatics
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**Data-
bases**



**Workflow
& DB**



**Workflow
& OR**



**Web &
Knowledge**

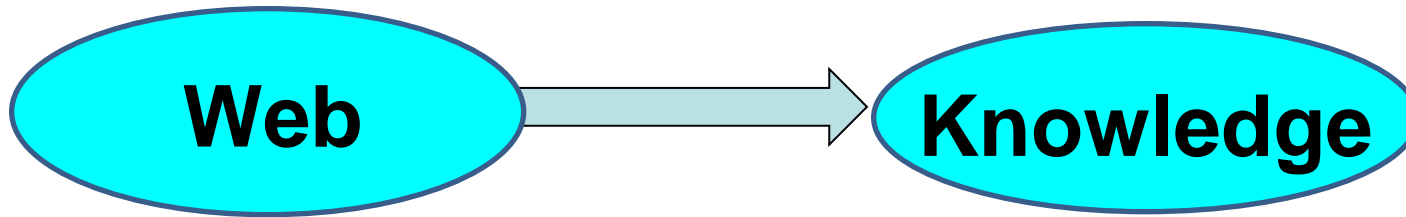


Self *



**P2P &
Cloud**

Knowledge from the Web



SUMO



Cyc



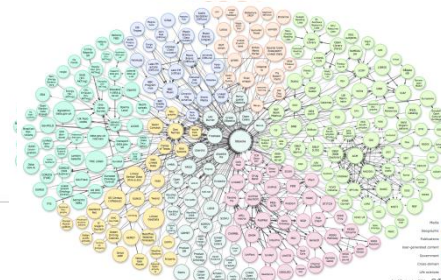
TextRunner/
ReVerb



YAGO-NAGA



WikiTaxonomy/
WikiNet



 **WolframAlpha** computational
knowledge engine

SIG.MA
SEMANTIC INFORMATION
MASHUP



IWP

Carnegie Mellon

ReadTheWeb

WordNet

freebase™

ConceptNet 5

True Knowledge®
The Internet Answer Engine™
BETA

BabelNet

Überblick

★ Wissen im Web: Was und Wozu?

★ Geschichte der O

★ Geschichte der W

★ Anwendungen und Chancen

★ Herausforderungen

★ Schlusswort

Spectrum of Machine Knowledge

factual:

bornIn (SteveJobs, SanFrancisco), hasFounded (SteveJobs, Pixar),
hasWon (SteveJobs, NationalMedalOfTechnology), livedIn (SteveJobs, PaloAlto)

taxonomic (ontology):

instanceOf (SteveJobs, computerArchitects), instanceOf(SteveJobs, CEOs)
subclassOf (computerArchitects, engineers), subclassOf(CEOs, businesspeople)

lexical (terminology):

means (“Big Apple“, NewYorkCity), means (“Apple“, AppleComputerCorp)
means (“MS“, Microsoft) , means (“MS“, MultipleSclerosis)

multi-lingual:

meansInChinese („乔戈里峰“, K2), meansInUrdu („کے ٹو“, K2)
meansInFr („école“, school (institution)), meansInFr („banc“, school (of fish))

temporal (fluents):

hasWon (SteveJobs, NationalMedalOfTechnology)@1985
marriedTo (AlbertEinstein, MilevaMaric)@[6-Jan-1903, 14-Feb-1919]

Knowledge for Intelligence

- entity recognition & **disambiguation**
- understanding **natural language** & speech
- knowledge services & **reasoning** for semantic apps
(e.g. deep QA)
- semantic search: **precise answers** to advanced queries
(by scientists, students, journalists, analysts, etc.)

- ★ FIFA 2010 finalists who played in a Champions League final?
- ★ Politicians who are also scientists?
- ★ German professors who founded Internet companies?
- ★ Relationships between
Alexander Pushkin, Evariste Galois, Johnny Ringo, and Hamlet?
- ★ Enzymes that inhibit HIV?
Influenza drugs for teens with high blood pressure?
...

Überblick

✓ **Wissen im Web: Was und Wozu?**

★ **Geschichte der O**

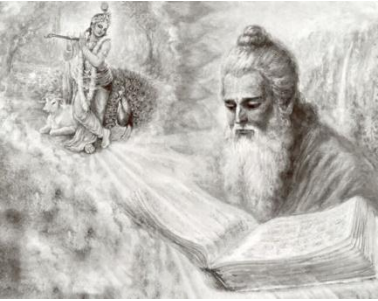
★ **Geschichte der W**

★ **Anwendungen und Chancen**

★ **Herausforderungen**

★ **Schlusswort**

Who Created the First Ontology in the History of Mankind?



Veda Vyasa
(1200 - 400 BC)



**Gottfried
Wilhelm
Leibniz**
(1646-1716)



**Denis
Diderot**
(1713-1784)

**Jean le Rond
d'Alembert**
(1717-1783)



**Leonardo
da Vinci**
(1452-1519)



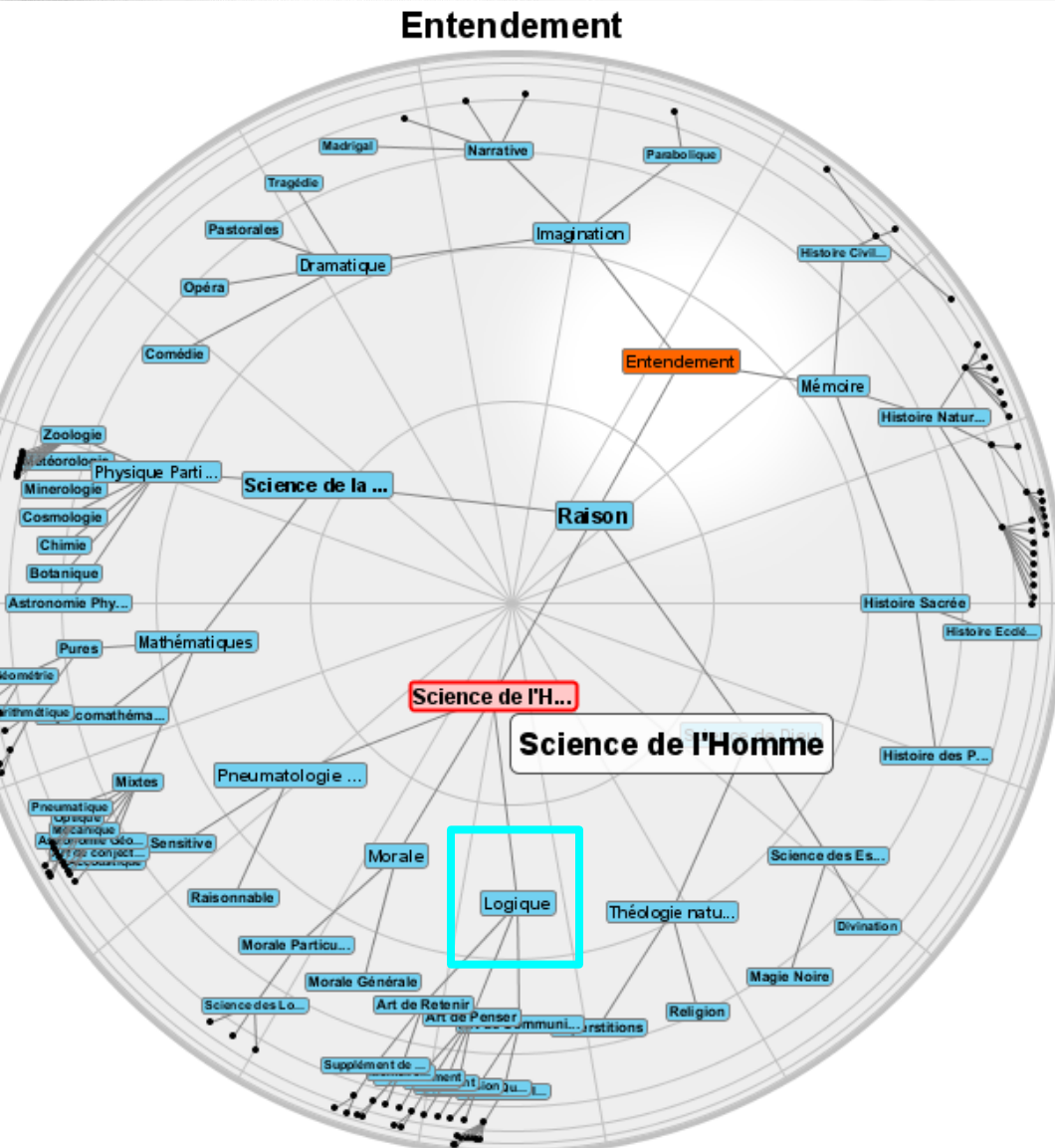
**Jimmy
Wales**
(1966 –)

**Larry
Sanger**
(1968 –)



Doug Lenat
(1950 –)

The World's First Ontology



L O G 637

LOGIA, (*Géog. anc.*) rivière d'Irlande, selon Ptolomée, *liv. II. chap. ij.* c'est-à-dire de l'Irlande; Camden croit que c'est *Logh-Foyle*, espece de golphe dans la province d'Ulster, au comté de Londonderry, qui se décharge dans l'Océan chalcédonien. (*D.J.*)

LOGIQUE, f. f. (*Philol.*) la logique est l'art de penser juste, ou de faire un usage convenable de nos facultés rationnelles, en définissant, en divisant, & en raisonnant. Ce mot est dérivé de λογος, terme grec, qui rendu en latin est la même chose que *sermo*, & en françois que *discours*; parce que la pensée n'est autre chose qu'une espèce de discours intérieur & mental, dans lequel l'esprit converse avec lui-même.

La *logique* se nomme souvent *dialectique*, & quelquefois aussi l'*art canonique*, comme étant un canon ou une règle pour nous diriger dans nos raisonnemens.

Comme pour penser juste il est nécessaire de bien appercevoir, de bien juger, de bien discourir, & de lier méthodiquement les idées ; il suit de-là que l'appréhension ou perception, le jugement, le discours & la méthode deviennent les quatre articles fondamentaux de cet art. C'est de nos réflexions sur ces quatre opérations de l'esprit que se forme la *logique*.

Le lord Bacon tire la division de la *logique* en quatre parties, des quatre fins qu'on s'y propose ; car un homme raisonne, ou pour trouver ce qu'il cherche, ou pour raisonner de ce qu'il a trouvé, ou pour retenir ce qu'il a jugé, ou pour enseigner aux autres ce qu'il a retenu : de-là naissent autant de branches de l'art de raisonner, savoir l'art de la recherche ou de l'invention, l'art de l'examen ou du jugement, l'art de retenir ou de la mémoire,

History of Ontologies: Modern Times

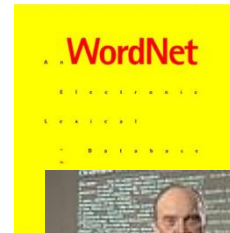


Cyc project (1984-1994)
cont'd by Cycorp Inc.



Doug Lenat:

„The more you know, the more
(and faster) you can learn.“



WordNet project
(1985-now)



**George
Miller**



**Christiane
Fellbaum**

WordNet Search - 3.1

- [WordNet home page](#) - [Glossary](#) - [Help](#)

Word to search for:

Display Options:

Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations

Display options for sense: (gloss) "an example sentence"

Noun

- **S: (n)** **enterprise**, [endeavor](#), [endeavour](#) (a purposeful or industrious undertaking (especially one that requires effort or boldness)) *"he had doubts about the whole enterprise"*
- **S: (n)** **enterprise** (an organization created for business ventures) *"a growing enterprise must have a bold leader"*
- **S: (n)** **enterprise**, [enterprisingness](#), [initiative](#), [go-ahead](#) (readiness to embark on bold new ventures)

$\forall x: \text{human}(x) \Rightarrow \text{male}(x) \vee \text{female}(x)$
 $\forall x: (\text{male}(x) \Rightarrow \neg \text{female}(x)) \wedge$
 $\quad (\text{female}(x) \Rightarrow \neg \text{male}(x))$
 $\forall x: \text{mammal}(x) \Rightarrow (\text{hasLegs}(x)$
 $\quad \Rightarrow \text{isEven}(\text{numberOfLegs}(x))$
 $\forall x: \text{human}(x) \Rightarrow$
 $\quad (\exists y: \text{mother}(x,y) \wedge \exists z: \text{father}(x,z))$
 $\forall x \forall e: \text{human}(x) \wedge \text{remembers}(x,e)$
 $\quad \Rightarrow \text{happened}(e) < \text{now}$

History of Ontologies: Modern Times

◦ direct hyponym / full hyponym

- S: (n) giant (an unusually large enterprise) *"Walton built a retail giant"*
- S: (n) collective (members of a cooperative enterprise)
- S: (n) business, concern, business concern, business organization, business organisation (a commercial or industrial enterprise and the people who constitute it) *"he bought his brother's business"; "a small mom-and-pop business"; "a racially integrated business concern"*
 - direct hyponym / full hyponym
 - S: (n) agency (a business or organization that provides a particular service, especially the mediation of transactions between two parties)
 - S: (n) advertising agency, ad agency (an agency that designs advertisement to call public attention to its clients)
 - S: (n) credit bureau (a private firm that maintains consumer credit data files and provides credit information to authorized users for a fee)
 - S: (n) detective agency (an agency that makes inquiries for its clients)
 - S: (n) employment agency, employment office (an agency that finds jobs for unemployed people)
 - S: (n) mercantile agency (an organization that provides ratings of other firms)
 - S: (n) news agency, press association, news organisation (an agency to collect news reports for newspapers and distributes it electronically)
 - S: (n) syndicate (a news agency that sells features or articles or photographs etc. to newspapers for simultaneous publication)
 - S: (n) service agency, service bureau, service firm (a business that makes its facilities available to others for a fee; achieves economy of scale)
 - S: (n) travel agency (an agency that arranges travel for clients)
- S: (n) firm, house, business firm (the members of a business organization that owns or operates one or more establishments) *"he worked for a brokerage house"*
 - S: (n) corporation, corp (a business firm whose articles of incorporation have been approved in some state)
 - S: (n) conglomerate, empire (a group of diverse companies under common ownership and run as a single organization)
 - S: (n) publishing conglomerate, publishing empire (a conglomerate of publishing companies)
 - S: (n) large cap (a corporation with a large capitalization) *"he works for a large cap"*
 - S: (n) small cap (a corporation with a small capitalization) *"this annual conference is a small cap conference"*
 - S: (n) close corporation, close company, privately held corporation, family business (a corporation that is not publicly owned by the members of a single family)
 - S: (n) publicly held corporation (stock is publicly traded but most is held by a few shareholders who have no plans to sell)
 - S: (n) shell corporation, shell entity (a company that is incorporated but has no assets or operations)
 - S: (n) Federal Deposit Insurance Corporation, FDIC (a federally sponsored corporation that insures accounts in national banks and other financial institutions)

+ many classes

+ many subclass relations

– no formal representation

– no instances of classes

History of Ontologies: This Millenium

Expressive yet tractable
logics for ontologies

RDFS, OWL

Powerful **tools** for creating
and maintaining ontologies

Protégé, KAON,
OntoBroker, OntoStudio, ...

Domain-specific ontologies
for semantic **applications**



Überblick

✓ **Wissen im Web: Was und Wozu?**

✓ **Geschichte der O**

★ **Geschichte der W**

★ **Anwendungen und Chancen**

★ **Herausforderungen**

★ **Schlusswort**

From Ontologies to Knowledge Bases

S: (n) enterprise (an organization created for business ventures) *"a growing enterprise must have a bold leader"*

- direct hyponym / full hyponym

- S: (n) giant (an unusually large enterprise) *"Walton built a retail giant"*
- S: (n) collective (members of a cooperative enterprise)
- S: (n) business, concern, business concern, business organization,

- S: (n) entrepreneur, enterpriser (someone who organizes a business venture and assumes the risk for it)

- has instance

- S: (n) Gates, Bill Gates, William Henry Gates (United States computer entrepreneur whose software company made him the youngest multi-billionaire in the history of the United States (born in 1955))
- S: (n) Sinclair, Clive Sinclair, Sir Clive Marles Sinclair (English electrical engineer who founded a company that introduced many innovative products (born in 1940))

+ focus on classes (T-Boxes)

– few or no instances of classes (A-Boxes)

in

- S: (n) capitalist (a person who invests capital in a business (especially a large business))
 - S: (n) person, individual, someone, somebody, mortal, soul (a human being) *"there was too much for one person to do"*
 - S: (n) organism, being (a living thing that has (or can

Knowledge Bases: New Opportunities



Steve Jobs

From Wikipedia, the free encyclopedia

For the biography, see [Steve Jobs \(biography\)](#).

Steven Paul Jobs (/ˈdʒɒbz/; February 24, 1955 – October 5, 2011)^{[4][5]} was an American businessman and inventor widely recognized as a charismatic pioneer of the [personal computer revolution](#).^{[6][7]} He was co-founder, chairman, and chief executive officer of [Apple Inc.](#) Jobs also co-founded and served as chief executive of [Pixar Animation Studios](#); he became a member of the board of directors of [The Walt Disney Company](#) in 2006, following the acquisition of Pixar by Disney.

In the late 1970s, Apple co-founder [Steve Wozniak](#) engineered one of the first commercially successful lines of personal computers, the [Apple II series](#). Jobs directed its aesthetic design and marketing along with [A.C. "Mike" Markkula, Jr.](#) and others. In the early 1980s, Jobs was among the first to see the commercial potential of [Xerox PARC's](#) mouse-driven [graphical user interface](#), which led to the creation of the [Apple Lisa](#) (engineered by Ken Rothmuller and [John Couch](#)) and, one year later, creation of Apple employee [Jef Raskin's](#) [Macintosh](#).

After losing a power struggle with the board of directors in 1985, Jobs left Apple and founded [NeXT](#), a [computer platform](#) development company specializing in the higher-education and business markets. NeXT was eventually acquired by Apple in 1996, which brought Jobs back to the company he co-founded, and provided Apple with the [NeXTSTEP](#) codebase, from which the [Mac OS X](#) was developed."^[8] Jobs was named Apple advisor in 1996, interim CEO in 1997, and CEO from 2000 until his resignation. He oversaw the development of the [iMac](#), [iTunes](#), [iPod](#), [iPhone](#), and [iPad](#) and the company's [Apple Retail Stores](#).^[9] In 1986, he acquired the computer graphics division of [Lucasfilm Ltd](#), which was spun off as [Pixar Animation Studios](#).^[10] He was credited in [Toy Story](#) (1995) as an executive producer. He remained CEO and majority shareholder at 50.1 percent until its acquisition by [The Walt Disney Company](#) in 2006,^[11] making Jobs Disney's largest individual shareholder at seven percent and a member of Disney's Board of Directors.^{[12][13]}

In 2003, Jobs was diagnosed with a [pancreas neuroendocrine tumor](#). Though it was initially treated, he reported a hormone imbalance, underwent a liver transplant in 2009, and appeared progressively thinner as his health declined.^[14] On medical leave for most of 2011, Jobs resigned as Apple CEO in August that year and was elected Chairman of the Board. On October 5, 2011, Jobs died of respiratory arrest related to his metastatic tumor. He



Jimmy Wales



Larry Sanger

Steve Jobs



Jobs holding a white [iPhone 4](#) at [Worldwide Developers Conference 2010](#)

Born	Steven Paul Jobs February 24, 1955 ^{[1][2]} San Francisco, California, U.S. ^{[1][2]}
Died	October 5, 2011 (aged 56) ^[2] Palo Alto , California, U.S.
Nationality	American
<i>Alma mater</i>	Reed College (dropped out)

Knowledge Bases: New



Steve Jobs

From Wikipedia, the free encyclopedia

For the biography, see [Steve Jobs \(biography\)](#).

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Born	Steven Paul Jobs <div></div> February 24, 1955 ^{[1][2]} <div></div> San Francisco, California, U.S. ^{[1][2]} <div></div>
Died	October 5, 2011 (aged 56) ^[2] <div></div> Palo Alto, California, U.S. <div></div>
Nationality	American <div></div>
<i>Alma mater</i>	Reed College (dropped out) <div></div>
Occupation	Co-founder, Chairman and CEO, Apple Inc., Co-founder and CEO, Pixar, Co-founder and CEO, NeXT Inc. <div></div>
Years active	1974–2011 <div></div>

Categories: [Steve Jobs](#) | [1955 births](#) | [2011 deaths](#) | [American adoptees](#) | [American billionaires](#) | [American chief executives](#) | [American computer businesspeople](#) | [American industrial designers](#) | [American inventors](#) | [American people of German descent](#) | [American people of Swiss descent](#) | [American people of Syrian descent](#) | [American technology company founders](#) | [American Zen Buddhists](#) | [Apple Inc.](#) | [Apple Inc. employees](#) | [Businesspeople from California](#) | [Businesspeople in software](#) | [Cancer deaths in California](#) | [Computer designers](#) | [Computer pioneers](#) | [Deaths from pancreatic cancer](#) | [Disney people](#) | [Internet pioneers](#) | [National Medal of Technology recipients](#) | [NeXT](#) | [Organ transplant recipients](#) | [People from the San Francisco Bay Area](#) | [Pescetarians](#) | [Reed College alumni](#)

Automatic Knowledge Base Construction

Steve Jobs

From Wikipedia, the free encyclopedia

For the biography, see *Steve Jobs* (biography).

Steven Paul Jobs (1955–1990; February 24, 1955–October 5, 2011)^[H] was an American businessman and entrepreneur widely recognized as a charismatic pioneer of the personal computer revolution.^[H] He was co-founder, chairman, and chief executive officer of Apple Inc. Jobs also co-founded and served as chief executive of Pixar Animation Studios. He became a member of the board of directors of The Walt Disney Company in 2005, following the acquisition of Pixar by Disney.

In the late 1970s, Apple co-founder Steve Wozniak engineered one of the first commercially successful lines of personal computers, the Apple II series. Jobs directed its aesthetic design and marketing along with a C. "Bud" Harris; J. and others. In the early 1980s, Jobs was among the first to see the commercial potential of Pixar's micro-driven graphical user interface, which led to the creation of the Apple Lisa (launched by Alan Kay) and the Macintosh and was one year later, creator of Apple employee and founder of NeXT.

After losing a power struggle with the board of directors in 1985, Jobs left Apple and founded NeXT, a computer software development company operating in the higher education and business markets. NeXT was eventually acquired by Apple in 1996, which brought Jobs back to the company he co-founded, and provided Apple with the NeXTSTEP software, from which the Mac OS X was developed.^[H] Jobs was named Apple's CEO in 1998, when CEO J. and CEO Steve Jobs took over his resignation. He oversaw the development of the iMac, iMac G4, iPod, iPhone, and iPad and the company's Apple Retail Stores.^[H] In 1988, he acquired the computer graphics division of Lucasfilm Ltd., which was spun off as Pixar Animation Studios.^[H] He was credited in *Toy Story* (1995) as an executive producer. He received CEO and majority shareholder of S. 1 percent and its acquisition by The Walt Disney Company in 2005.^[H] During Apple's largest individual shareholder at some point and a member of Disney's Board of Directors.^[H]

In 2003, Jobs was diagnosed with a previously undetected cancer. Though it was initially treated, he reported a herniated embolism, underwent a liver transplant in 2009, and appeared progressively thinner as his health declined.^[H] On medical leave for most of 2011, Jobs resigned as Apple CEO in August that year and was elected Chairman of the Board. On October 5, 2011, Jobs died of respiratory arrest related to his metastatic cancer. He



map 300K Wikipedia categories
onto 150K WordNet classes

WordNet Search - 3.1

[WordNet home page](#) - [Glossary](#) - [Help](#)

Word to search for:

Display Options: (Select option to change)

Key: "S-" = Show Synset (semantic relations), "W-" = Show Word (lexical relations)
Display options for sense: (gloss) "an example sentence"

Noun

- **S: (n)** enterprise, endeavor, endeavour (a purposeful or industrious undertaking (especially one that requires effort or boldness)) "he had doubts about the whole enterprise"
- **S: (n)** enterprise (an organization created for business ventures) "a growing enterprise must have a bold leader"
- **S: (n)** enterprise, enterpriseness, initiative, go-ahead (readiness to embark on bold new ventures)

American billionaires

Technology company founders

Apple Inc.

Deaths from cancer

Internet pioneers

tycoon, magnate

entrepreneur

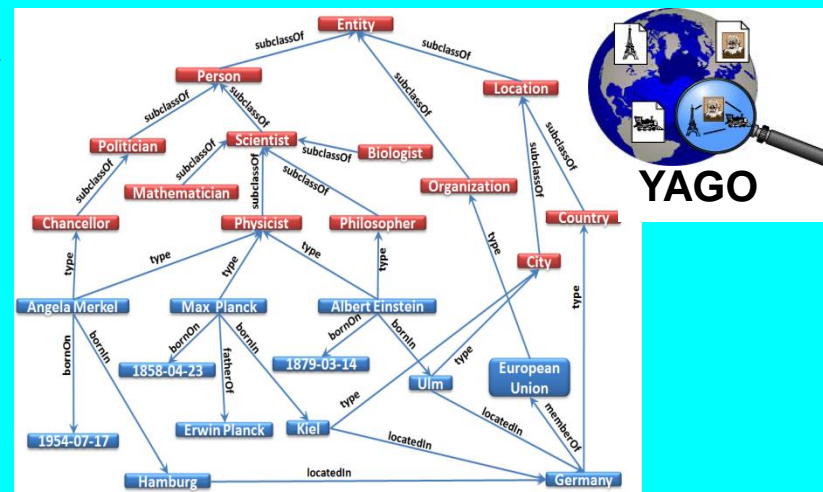
pioneer, innovator

pioneer, colonist

Integrating entities & facts from Wikipedia
with semantic classes in WordNet

→ YAGO knowledge base:

10 Mio. entities, 350 000 classes,
180 Mio. facts, 100 relations,
100 languages, 2 Bio. triples,
95% accuracy



Large-Scale Universal Knowledge Bases

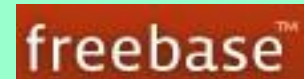
Yago: 10 Mio. entities, 350 000 classes,
180 Mio. facts, 100 properties, 100 languages
high accuracy, no redundancy, limited coverage



Dbpedia: 4 Mio. entities, 250 classes,
500 Mio. facts, 6000 properties
high coverage, live updates



Freebase: 25 Mio. entities, 2000 topics,
100 Mio. facts, 4000 properties
interesting relations (e.g., romantic affairs)

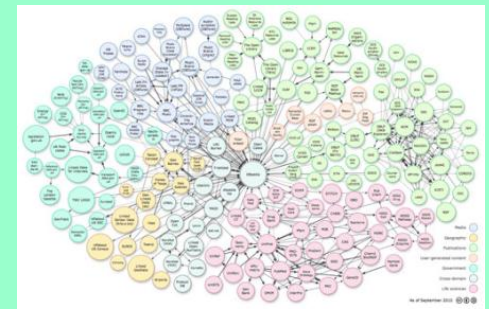


NELL: 300 000 entity names, 300 classes, 500 properties,
1 Mio. beliefs, 15 Mio. low-confidence beliefs
learned rules



and more ...

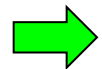
plus Linked Data



Knowledge Base Population

hasAdvisor (<person>, <person>) AlmaMater (<person>, <university>)

*Georg Lausen was one of **Wolffried Stucky's** **best students***
*Klaus Dittrich and **his advisor Lockemann** wrote the DB handbook*
*Gerhard Goos and **his Bavarian advisor Bauer** wrote a textbook*
*Emmy Noether was **helped by** her **advisor Paul Gordan***
*Emmy Noether was **helped by** her colleague **Weyl***
*Andreas Oberweis is one of **Stucky's academic descendants***
*Stucky and **his advisor Hotz** never **co-authored** any paper*
*Ottmann and **Maurer** **co-authored** seven papers*



hasAdvisor (GeorgLausen, WolffriedStucky)

hasAdvisor (GerhardGoos, F.L.Bauer)

...

AlmaMater (Georg Lausen, TU Karlsruhe)

AlmaMater (Emmy Noether, TU Erlangen)

...

Pattern-based Gathering
(statistical evidence)

+

Constraint-aware Reasoning
(logical consistency)

Pattern-based Gathering of Fact Candidates

Hearst'92 ; Brin'98: Dipre; Agichtein'00: Snowball;
Etzioni'04: KnowItAll; Cimiano et al. '04: Text2Onto; ...

Facts & Fact Candidates

(GeorgLausen, WolfriedStucky)

(EmmyNoether, PaulGordan)

(Andreas, Georg)

(Rudi, Erich)

(Angela, Lutz)

(Karl-Theodor, Peter)

(Wolffried, Günter)

(Rudi, SirTim)

(Angela, Emmy)

(Karl-Theodor, Angela)

(Angela, Berlin)

Patterns

X and his advisor Y

X under the guidance of Y

X and Y in their paper

X co-authored with Y

X rarely met his advisor Y

...

- good for **recall**
- noisy, drifting
- **not robust** enough for high precision

Constrained Reasoning for Logical Consistency

Use **knowledge** (consistency constraints)
for joint reasoning on hypotheses
and pruning of false candidates

ground atoms:

hasA(Rudi, Erich)
hasA(Emmy, Paul)
hasA(Emmy, SirTim)

Steffen, Rudi)
Rudi, Steffen)
Angela, Berlin)

$\forall x, y, z: \text{hasA}(x,y) \wedge \text{hasA}(x,z) \Rightarrow y=z$
 $\forall x, y: \text{hasA}(x,y) \Rightarrow \neg \text{hasA}(y,x)$
 $\forall x, y, p: \text{occurs}(x, y, p) \wedge \text{goodPattern}(p, \text{hasA})$
 $\Rightarrow \text{hasA}(x,y)$
 $\forall x, y, p: \text{occurs}(x, y, p) \wedge \text{hasA}(x,y)$
 $\Rightarrow \text{goodPattern}(p, \text{hasA})$
 $\forall x, y: \text{hasA}(x,y) \Rightarrow \text{type}(x)=\text{Person}$
 $\forall x, y: \text{hasA}(x,y) \Rightarrow \text{type}(y)=\text{Scientist}$
 $\forall x, y: \text{hasA}(x,y) \Rightarrow \text{hasStudent}(y,x)$
 $\forall x, y: \text{AlmaMater}(x,y) \Rightarrow \text{type}(y)=\text{University}$
 $\forall x,y,u: \text{hasA}(x,y) \wedge \text{AlmaMater}(x,u) \Rightarrow \text{FacultyOf}(y,u)$
 $\forall x,y,s,t: \text{hasA}(x,y) \wedge \text{gradYear}(x,s) \wedge \text{gradYear}(y,t) \Rightarrow t < s$

Constrained Reasoning for Logical Consistency

Use **knowledge** (consistency constraints)
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$\forall x, y, z: \text{hasA}(x,y) \wedge \text{hasA}(x,z) \Rightarrow y=z$
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 $\forall x, y: \text{hasA}(x,y) \Rightarrow \text{type}(x)=\text{Person}$
 $\forall x, y: \text{hasA}(x,y) \Rightarrow \text{type}(y)=\text{Scientist}$
 $\forall x, y: \text{hasA}(x,y) \Rightarrow \text{studentOf}(y,x)$
 $\forall x, y: \text{AlmaMater}(x,y) \Rightarrow \text{type}(y)=\text{University}$
 $\forall x,y,u: \text{hasA}(x,y) \wedge \text{AlmaMater}(x,u) \Rightarrow \text{FacultyOf}(y,u)$
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ground atoms:

hasA(Rudi, Erich)
hasA(Emmy, Paul)
~~hasA(Emmy, SirTim)~~
hasA (Steffen, Rudi)
~~hasA (Rudi, Steffen)~~
~~hasA (Angela, Berlin)~~
...

Find **consistent subset(s)** of atoms (“possible world(s)“, “the truth“)
→ customized Weighted MaxSat solver for set of clauses
→ max posterior for probabilistic factor graph (Markov Logic etc.)

Überblick

- ✓ **Wissen im Web: Was und Wozu?**
- ✓ **Geschichte der O**
- ✓ **Geschichte der W**
- ★ **Anwendungen und Chancen**
- ★ **Herausforderungen**
- ★ **Schlusswort**

Deep Question Answering

William Wilkinson's "An Account of the Principalities of Wallachia and Moldavia" inspired this author's most famous novel

This town is known as "Sin City" & its downtown is "Glitter Gulch"

As of 2010, this is the only former Yugoslav republic in the EU

99 cents got me a 4-pack of Ytterlig coasters from this Swedish chain



question
classification &
decomposition



knowledge
back-ends



WIKIPEDIA
The Free Encyclopedia



freebase™



YAGO

D. Ferrucci et al.: Building Watson: An Overview of the DeepQA Project. AI Magazine, Fall 2010.

www.ibm.com/innovation/us/watson/index.htm

Deep QA: Even Deeper

Q: Which US city has two airports [Jeopardy show 16-Feb-2011]
named after a war hero and a world war battle?

A Web Jan 2011: Edward O'Hare, Charles de Gaulle, ...

A Watson: Toronto

A: Chicago

A Web Jan 2012: Watson

Q: Which genetically caused connective tissue disorder
has severe symptoms regarding the aorta
and ophthalmologic subluxation?

A: Marfan Syndrome



→ **QALD@ESWC'12 competition:**
Question Answering over Linked Data

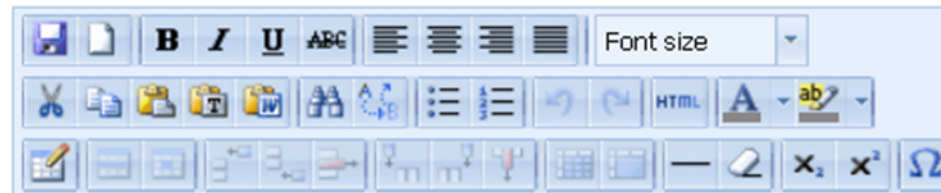
Named Entity Disambiguation

Mention Extraction:

Stanford NER

Manual

You can manually tag the mentions by putting them between [[and]]. HTML Tables are automatically disambiguated in the manual mode.



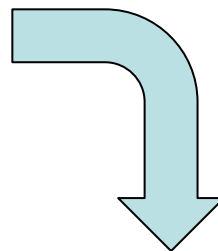
Rudi from KIT and Gerhard from MPI work at computer science institutes. Both do research on ontologies, databases, and knowledge management.

5s, 283ms

Types tag cloud

Focused Types tag cloud

[KIT] and [Gerhard Ertl] Gerhard
[Max Planck Institute for Computer Science] MPI work at computer
science institutes, databases,



Run Information

Graph

Removal Steps

- L1 (prior-sim) Mean: 1.9375000224999999
- L1 (prior-sim) Variance: -0.9882812471874998
- Number of fixed mention by coherence robustness: 0
- Graph Algorithm:
mpi.aida.graph.algorithms.CocktailPartySizeConstrained
- Diameter: 1
- Average Edge Weight: 0.1734689162752388
- Distance Threshold: 0.4132655418623806
- Number of Initial Nodes: 437
- Number of Initial Edges: 455
- Number of Initial Mentions: 4
- Number of Initial Entities: 433

Input Type:TEXT Overall runtime:5s, 283ms

Types list

Types tag cloud

Focused Types tag cloud

Path: p

Disambiguate

[Rudi Dutschke] Rudi from [Drum kit] KIT and [Gerhard Ertl] Gerhard
from [Max Planck Institute for Computer Science] MPI work at computer
science institutes. Both do research on ontologies, databases,
and knowledge management.

AIDA: Accurate Online Disambiguation

Disambiguation Method:

prior

prior+sim

prior+sim+coh

Parameters: (defaults should be OK)

Prior-Similarity-Coherence balancing ratio:

prior VS. sim. balance = 0.3

(prior+sim.) VS. coh. balance 0.44



Ambiguity degree 10



Coherence robustness test threshold:

0.7



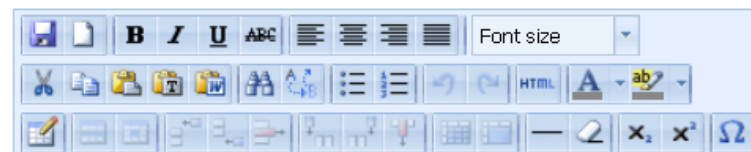
Entities Type Filters:

Enter the types here

Mention Extraction:

Stanford NER Manual

You can manually tag the mentions by putting them between [[and]]. HTML Tables are automatically disambiguated in the manual mode.



Rudi from KIT and Gerhard from MPI work at computer science institutes. Both do research on ontologies, databases, and knowledge management.

Input Type:

115ms

Types list

Focused Typ

[Rudi Studer]

Institute of Te

[Gerhard Weil

Planck Institut

Science]MPI

science inst

on ontologie

knowledge r

Run Information

Graph

Removal Steps

0: Rudi

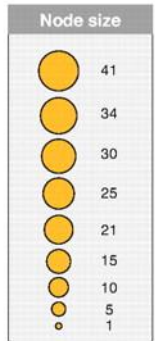
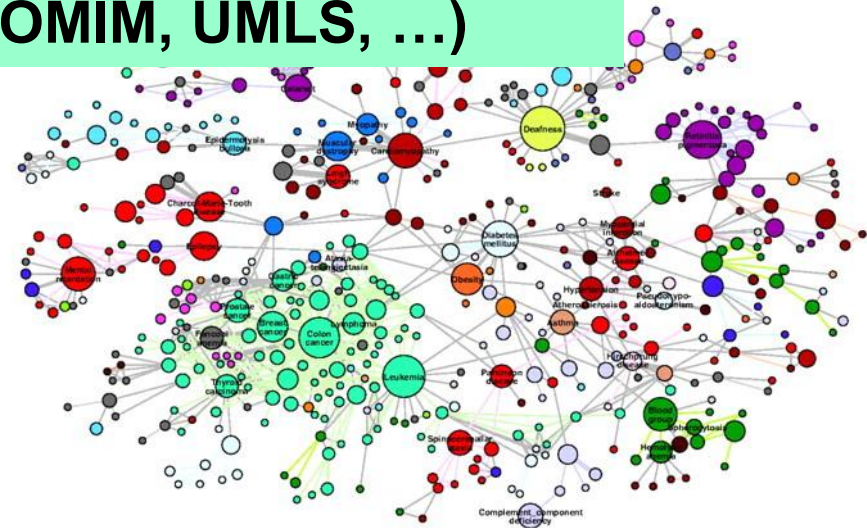
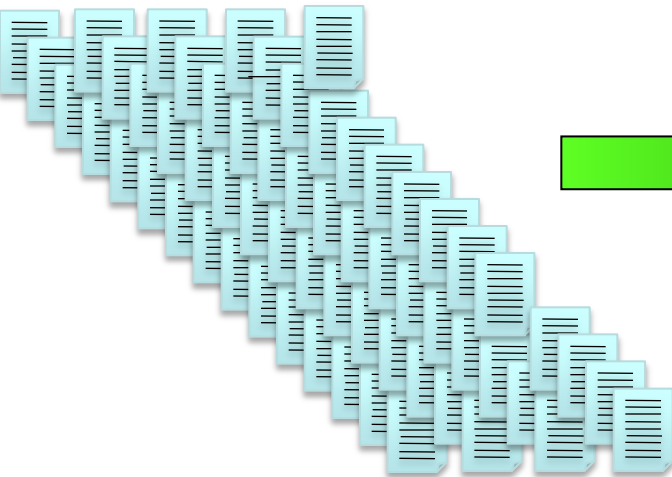
Candidate Entity	ME Similarity	Weighted Degree
Rudi_Studer	0.44	0.550777141743559
Rudi_Dutschke	0.0	0.2972612176317867
Rudi_Fischer	0.0	0.17340019029846232
Rudi_Ball	0.034223177348039646	0.16881885864137852
Rudi_Smidts	0.0	0.13119188130762555
Rudolf_Rademacher	0.0	0.12844473626155406
Rhodes	0.0	0.12840397071152432
Rudi_M\u002e_Brewster	0.0	0.12522588369654178
Rudi_Dornbusch	0.0	0.12254665035273948
Rudi_Strittich	0.0	0.12114256430208516
Rudi_Hedman	0.0	0.1186455090771368
Rudi_Hoffmann	0.0	0.11604333353374176
Rudi_Gutendorf	0.0	0.11126060273536008
Rudi_Altig	0.0	0.1096278264291823
Rudi_Gernreich	0.0	0.09037409531929784
Rudi_Balling	0.025550469191685632	0.02555046919168563
Rudi_Thomaes	0.0	0.0
Rudi_Gores	0.0	0.0
Donika_Rudi	0.0	0.0
Rudi_Carrell	0.0	0.0
Rudi_Arnstadt	0.0	0.0
Rudi_Johnson	0.0	0.0
Rudi_Holzappel	0.0	0.0
Rudi_Swiegers	0.0	0.0

<http://www.mpi-inf.mpg.de/yago-naga/aida/>

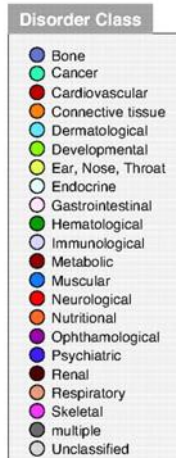
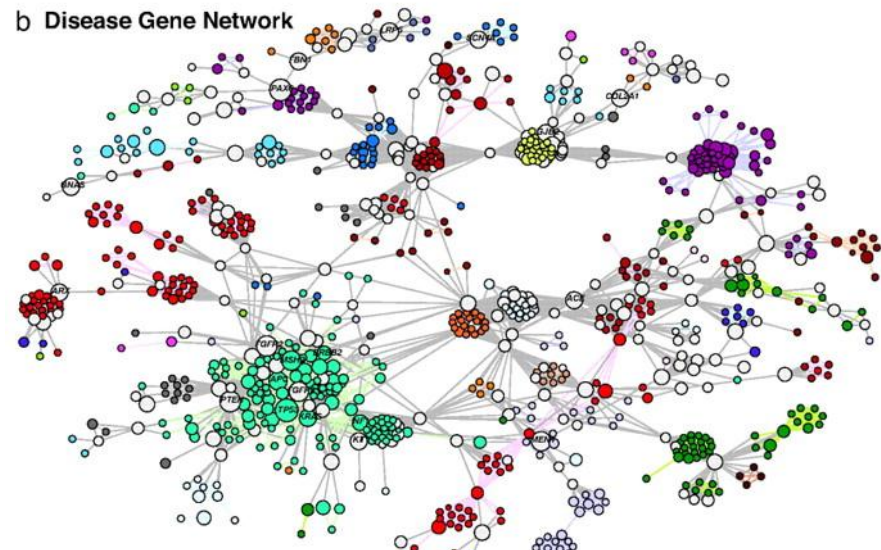
Application: Disease Networks

combine w/ life-science ontologies
(GO, BioPax, OMIM, UMLS, ...)

PubMed



b Disease Gene Network



Collective Knowledge for Smart Logistics

highly instrumented world of sensors:

RFID, GPS, mobiles, cameras, tweets, social media, etc.

→ monitor events, detect emergent situations, real-time reaction



**City of the Future
will depend on:**

- Smart energy
- Smart traffic
- Smart health
- Real-time data analytics
- Knowledge bases
- Semantic reasoning
- Online optimization
- Self organization
- Scalable computing

Überblick

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- ✓ Geschichte der O
- ✓ Geschichte der W
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- ★ Herausforderungen
- ★ Schlusswort



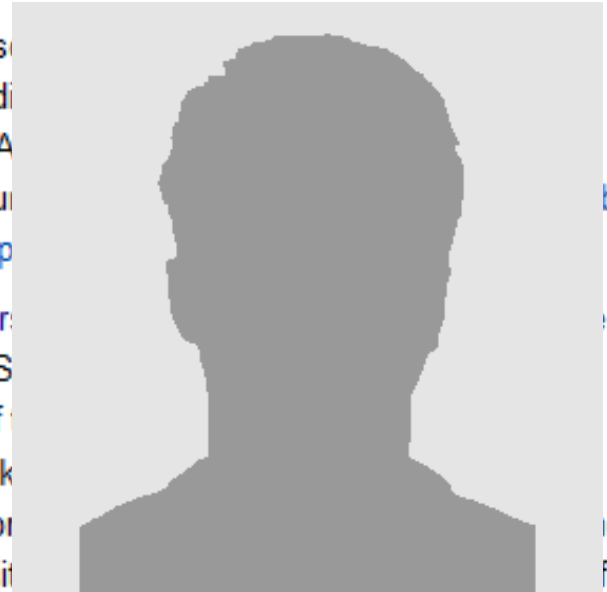
Next-Generation Wikipedia

Rudi Studer

What's Wrong Here ?

From Wikipedia, the free encyclopedia

Rudi Studer (born 1951 in Stuttgart) is a German computer scientist and professor at the knowledge management research group at the Institute AIFB and one of the directors of the Research Institute (KSRI). He is former president of the Semantic Web Science Association and numerous programme committees and editorial boards. He was one of the inaugural chairs of the *Semantics*, a position he held until 2007. He is a co-author of the *Semantic Wikipedia*. He obtained a degree (1975) and a PhD (1982) in Computer Science at the University of Karlsruhe. He was project leader and manager at IBM Germany, Institute of Knowledge Based Systems, and professor in Karlsruhe^[3]. Since then, he led his research group to become one of the leading groups in Semantic Web technology, and he played a leading role in establishing highly acknowledged conferences and journals in this area. Rudi Studer is also director in the department Information Technologies at the University of Karlsruhe, presidents of the FZI Research Center for Information Technologies at the University of Karlsruhe, and the spin-off company *ontoprise GmbH* that develops semantic applications. He is a former director of the *Lab Lower Saxony* in Hannover. He is a member of AAAI, ACM, IEEE, IFIP Working Group on Semantic Web, and German Informatics Society (GI).



no photo(s) !
no infobox !

His current research interests span over the main topics important for Semantic Web technology, including knowledge management, knowledge engineering, discovery and learning, ontology management, data and text mining, semantic web services, and peer-to-peer systems.

Bibliography

Multimodal Knowledge

ImageNet: Photos for WordNet [Deng et al.: CVPR'09]

<http://www.image-net.org>

Entrepreneur, enterpriser

Someone who organizes a business venture and assumes the risk for it

1228
pictures

81.77%
Popularity
Percentile



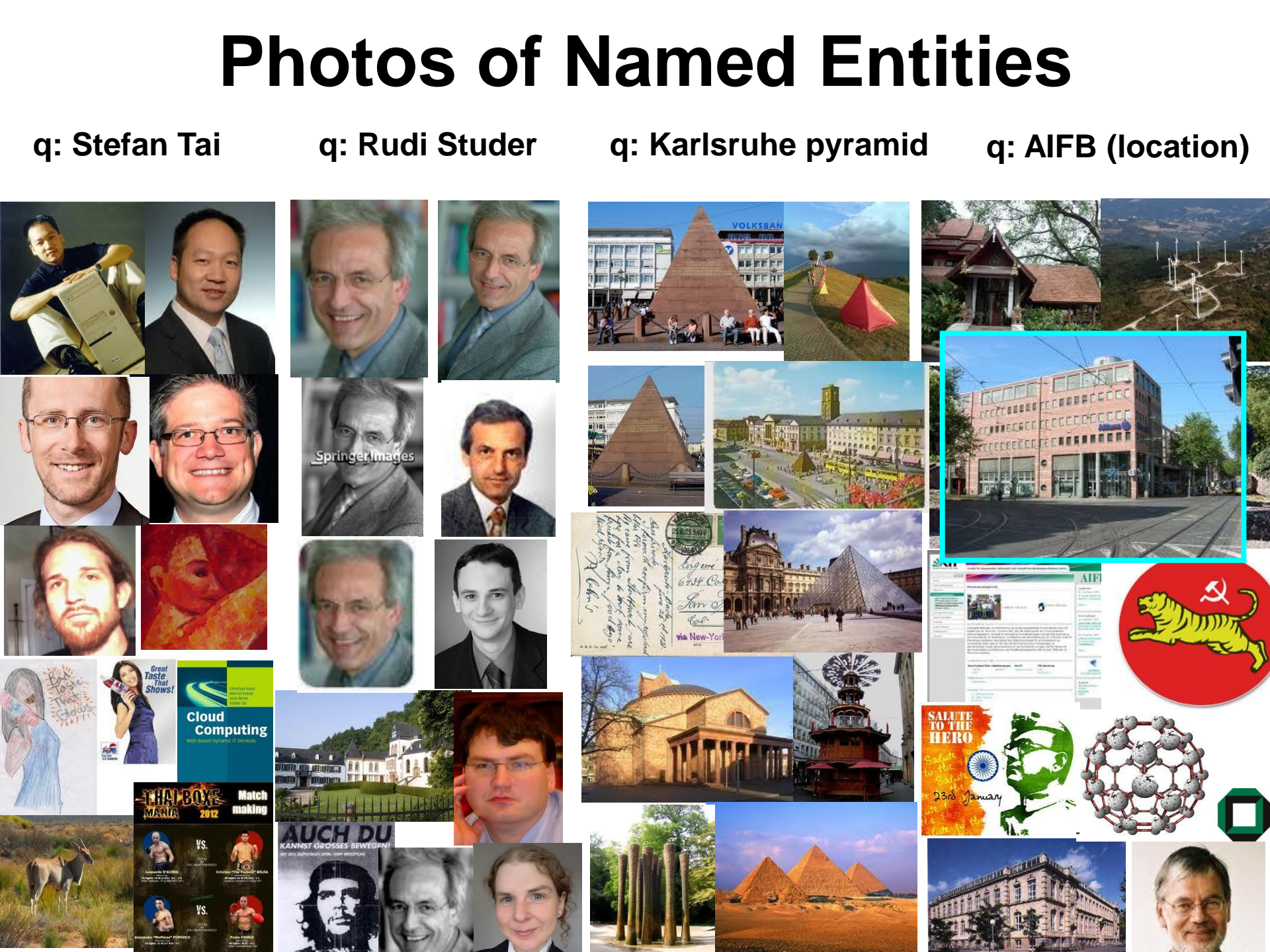
- contestant (98)
- communicator (136)
- adult, grownup (205)
- adventurer, venturer (7)
- anomaly, unusual person (7)
- applicant, applier (6)
- appointee, appointment (0)
- capitalist (62)
 - businessperson, bourgeois
 - accountant, comptroller,
 - shipper (1)
 - merchant, merchandise
 - importer (0)
 - exporter (0)
 - entrepreneur, enterprise
 - businesswoman (0)
 - businessman, man of a
 - agent, factor, broker (3)
 - account executive, accot
 - supplier, provider (9)
- financier, moneyman (2)
- holder, bearer (0)
- investor (5)

Treemap Visualization

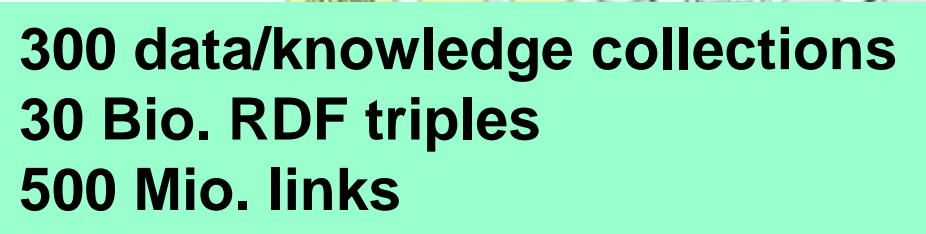
Images of the Synset

Downloads



[illegible][illegible][illegible][illegible][illegible]

Web of Linked Data



From Linked Data to Linked Knowledge

yago/wordnet:Actor109765278

yago/wordnet:Artist109812338

imdb.com/name/nm0910607/

yago/wikicategory:ItalianComposer

imdb.com/title/tt0361748/

dbpedia.org/resource/Ennio_Morricone

dbpedia.org/resource/Rome

rdf.freebase.com/ns/en.rome_ny

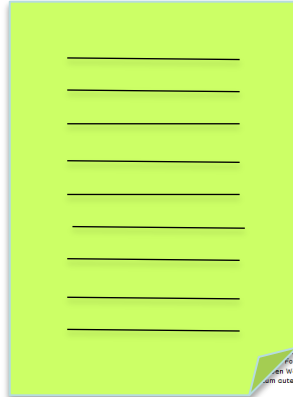
data.nytimes.com/51688803696189142301

data quality:
automatic, dynamic,
high coverage !

geonames.org/5134301/city_of_rome

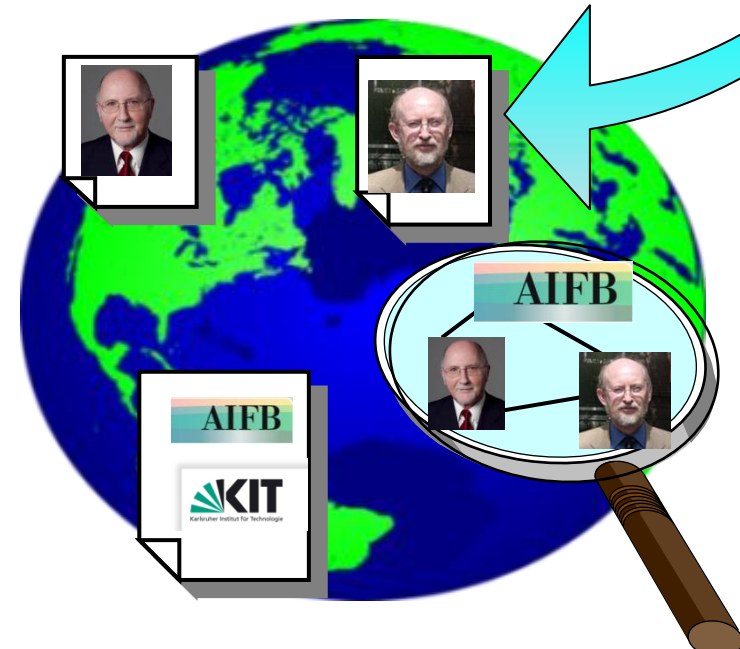
N 43° 12' 46" W 75° 27' 20"

Lifting the Web to Entities & Relations



**Entity Detection &
Disambiguation
→ generate RDFa ...**

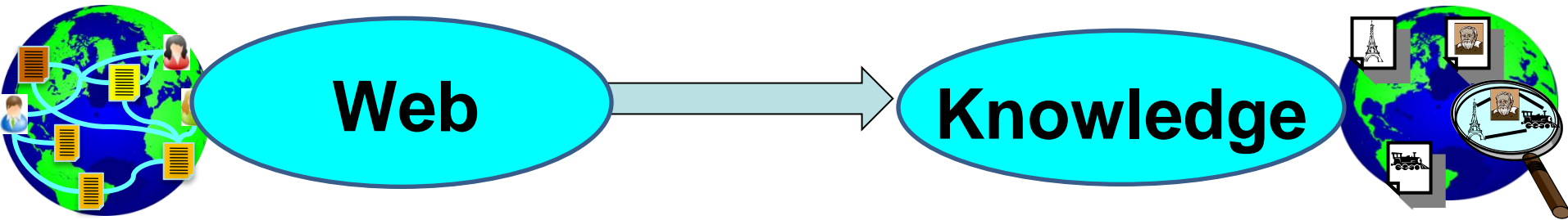
**Semantic
authoring**



Überblick

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- ✓ **Geschichte der O**
- ✓ **Geschichte der W**
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- ★ **Schlusswort**

Take-Home Message



- **Machine Knowledge from Web Sources: finally real !**
- **Ontologies → Knowledge Bases → Applications**
(semantic representations + rich instance data)
- **Exciting opportunities and challenges**
- **Numerous applications in:**
 - **business** (enterprise knowledge)
 - **science** (life sciences, logistics, humanities, etc.)
 - **society** (health, energy, etc.)

Schlusswort

Logics &
Formal
Concepts

Ontologies

Collective
Knowledge
& Linked Data

Cloud
Computing

Business
Services

Smart
Energy

40 Jahre AI & FB
in einem Haus !



Herzlichen Glückwunsch
und weiter so !